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GOVERNMENT OF THE PROVINCE OF ALBERTA

OIL AND GAS

CONSERVATION BOARD

REPORT TO

THE LIEUTENANT GOVERNOR IN COUNCIL

WITH RESPECT TO THE APPLICATION OF
GREAT CANADIAN OIL SANDS LIMITED
UNDER PART VIA OF
THE OIL AND GAS CONSERVATION ACT

November, 1960

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THE APPLICATION OF
GREAT CANADIAN OIL SANDS LIMITED
UNDER PART VIA OF
THE OIL AND GAS CONSERVATION ACT

I

INTRODUCTION

The application of Great Canadian Oil Sands Limited under Part VIA of The Oil and Gas Conservation Act is the first of its type to be considered by the Board. Prior to the holding of the public hearing of the application as required under the Act, the Board gave considerable thought to what its concern should be with respect to applications made under Part VIA.

The Board had determined that it must be concerned with the overall conservation aspects of the scheme, with the impact of the proposed sale of the synthetic crude oil from the oil sands on the market for conventionally produced crude oil and with the technical and economic feasibility of any operation proposed on a commercial scale.

In considering the overall conservation aspects of the scheme the Board must determine whether, in its opinion, the proposed operation would result in the effective processing of substantially all of the oil sands opened up by the scheme, and whether an appropriate proportion of the oil contained in the oil sands would be recovered. A related matter which the Board should also determine is whether or not the proposed methods of disposing of the by-products and gaseous, liquid and solid wastes are suitable ones, having regard to atmospheric, ground and surface water or river pollution, as well as preservation of the stability and general appearance of the terrain.

The overall impact of the proposed sale of the synthetic crude oil from the oil sands on the market for conventional crude oil is one which must be considered from two points of view. On the one hand, the Board believes it to be in the interests of the Province to have some commercial development of the oil sands even at this time when the productive capacity of conventional wells in the Province so greatly exceeds the available market. Some commercial development of the oil sands is desirable to demonstrate that oil from this resource is economically recoverable. Moreover, the industry which would result would be of value to the Province, and particularly to the McMurray area, for its own sake. On the other hand, it cannot be considered in the interests of the Province to have the oil sands developed at this time to an extent where the synthetic crude oil produced from the oil sands would have a serious effect on the market for conventionally produced crude oil in the Province. The Board, therefore, believes it important that it make a careful assessment of the extent of present and future curtailment of the market for conventionally produced Alberta crude oil and consider any proposed scheme in the light of the curtailment which would result from it.

The Board also considers that it has a responsibility to make the best assessment it can of the overall technical and economic feasibility of any operation proposed on a commercial scale. The Board recognizes that if it, with the approval of the Lieutenant Governor in Council, were to give approval for a large scale scheme which should turn out to be a serious failure either for technical or economic reasons, serious discredit to the recoverability of oil from the oil sands might result which, in turn, might delay their development for many years. The Board recognizes only too well that it cannot determine either the technical or economic feasibility in any real absolute sense. All it can do is to weigh and assess the evidence on these matters and make some assessment of the technical and economic practicability of the proposal.

It is with these considerations in mind that the Board has reviewed the representations of the applicant and of the interveners and that it now assesses the application.

II

THE APPLICANT AND ITS APPLICATION

Great Canadian Oil Sands Limited is a Dominion Company and registered under The Companies Act of Alberta on December 6, 1954. (It is referred to herein as "Great Canadian".) It was formed about that time to carry forward the work and interests of its predecessors, L. R. Champion and Oil Sands Limited. The predecessors had been interested in oil sands development since approximately 1939 and had participated in pilot plant operations in the Athabasca area.

Two of the directors of Great Canadian are connected with Fry & Company Limited, a firm of investment dealers in Toronto. Two other directors are also Toronto residents and a fifth is the Managing Director, Thomas P. Clarke of New York.

In 1955, Fry provided $375,000 in equity financing and in 1957 a further $240,000, the money coming largely, if not wholly, from Ontario investers. In 1957 also, $240,000 was obtained from the Rio Tinto Mining Company, an English company, by the sale of 80,000 shares at $3.00 per share, and this company's Canadian subsidiary has indicated an interest in further participation. Great Canadian proposes that in financing its project another 2,000,000 shares would be sold at a par value of $10.00 each in the Canadian, American and English markets.

Shortly after the applicant company was formed it participated in discussions with Provincial Government and Board authorities and representatives of the petroleum industry in the Province, bearing on legislation affecting the production of hydrocarbons from oil sands. One result of the discussions was the enactment of The Bituminous Sands Act, Statutes of Alberta, 1955, chapter 57. Some provisions of this Act have been incorporated into other statutes, and some have been modified by amendments since 1955. However, it may be noted that two of the key provisions of the 1955 Act provided

1. that The Oil and Gas Resources Conservation Act, 1950, does not apply to the recovery of oil sands by surface excavation methods, nor to disposal or transportation of products from the sands so recovered, and
2. that liquid hydrocarbons produced from oil sands are included in the definition of "oil" in The Pipe Line Act, 1952, and the operator of a line that can carry such hydrocarbons, processed to be marketable, might be declared a common carrier required to carry such oil and any other oil.

The first of these provisions was in accordance with the expressed desire of the oil industry to have oil from sands excluded from the oil market prorationing scheme.

Great Canadian is the lessee of Bituminous Sands

Lease No. 14, one of the assets it acquired from the Champion interests. This lease entitles it to work the sands in an area of some 4,177 acres along the Athabasca River about fifty miles north of McMurray. The applicant, by its agreement with Sun Oil Company, Abasand Oils Limited and Canadian Oil Companies, Limited is entitled to a sublease of one-half the leasehold of Bituminour Sands Lease No. 4, and if the lessee decides to sublease the remainder, the applicant will have the right of first refusal of that sublease. Bituminous Sands Lease No. 4 is held by Sun Oil Company, the assignee of the original lessee, Abasand Oils Limited. It covers an area of 3,898.2 acres, also along the Athabasca River, but somewhat nearer McMurray.

The application was made pursuant to section 5, subsection (3) of The Oil and Gas Conservation Act, by letter under date of March 14, 1960. After amendment of the Act, effective April 11, 1960, the application was continued and the hearing held under the new Part VIA of the Act. The applicant asks approval of a scheme to produce 11,500,000 barrels per year of synthetic crude oil and other by-products derived from oil sands to be taken from Bituminous Sands Lease No. 4. The synthetic crude oil would be delivered by pipe line to Edmonton.

The application was heard in Calgary on June 8, 9 and 10 and July 7, 8 and 9, 1960.

III

INTERVENERS

The following registered as interested parties at the hearing:

Counsel	Representing
E. J. Chambers, Q.C.	A group consisting of Cities Service Athabasca, Inc. Imperial Oil Limited Richfield Oil Corporation Royalite Oil Company, Limited
J. E. Prothroe	Can-Amera Oil Sands Development Ltd.

The Cities Service group hold a number of bituminous sands leases in the McMurray-Ells Lake area, and are engaged in an extensive research program with a view to the commercial development of oil sands. The several members of the group are also engaged in oil and gas production by the ordinary methods in the Province. At the hearing the Cities Service witnesses discussed the feasibility of some of the steps of the process proposed by the applicant in the light of their experience.

Can-Amera Oil Sands Development Ltd. owns a process for the separation of the oil from the sands by the use of centrifugal force. Its witness, Gordon R. Coulson, presented his opinion of results obtained during previous pilot plant operations with a less sophisticated application of the oil extraction methods proposed by Great Canadian. His conclusion was that such methods are wasteful.

IV

DETAILS OF THE PROPOSAL

The overall proposal consists essentially of the following operations and procedures:

1. Mining and conveying of the oil sands.
2. Separation of oil from the oil sands.
3. Preliminary refining of the oil to yield a synthetic crude oil.
4. Waste disposal.
5. Pipe line transportation of the synthetic crude oil to Edmonton.
6. Marketing of the synthetic crude oil
7. Method of financing.

In the following these phases, as they are proposed by the applicant, are described briefly. Further details may be obtained by referring to the various exhibits presented during the hearing. Particularly helpful is the summary report by Great Canadian which was marked Exhibit No. 1.

1. Mining and Conveying of the Oil Sands

Oil sands would be mined by the open pit method from benches cut into the oil sands face. These benches would be made accessible by ramps so that equipment could be moved from one level to another during the mining operation.

Each piece of equipment used in the mining operation would be mounted on tracks. To allow service from a minimum spare parts inventory, the same kind and size of equipment would be used wherever possible, particularly in the case of the digging, conveying and stacking equipment. Duplicate excavators and stackers would be provided and the belt conveyors used in the mining operation would be of a standard design.

The actual digging would be done by large crawler-mounted bucket wheel excavators, one for removing the overburden and one for mining the oil sands. It is anticipated that the overburden would be removed during the summer months, thus releasing the overburden excavator for any emergency which might arise in the mining of the oil sands during the winter.

The overburden from the excavator would be handled by a shiftable conveyor system and during the first three years of operation deposited in a temporary disposal area located nearby. The applicant considers that after that time sufficient room would be available in the opened mine so that the overburden could be transported there by means of additional conveyors and spread with a crawler-mounted stacking machine.

The oil sands would be conveyed from the bucket wheel excavator to the oil extraction plant by means of a similar shiftable conveyor system. The sand tailings from the extraction plant would be sluiced to an initial tailings area for the first three years but after that would be conveyed to the mined out area and distributed there by a stacker. Under normal operation a second stacker would be used to aid disposal.

A brief description of the major pieces of equipment to be used in the mining and conveying phase of the proposed operation and their functions follows:

(a) Bucket Wheel Excavator:

This machine would consist of a large bucket wheel fitted with two conveying arms. As the wheel rotates the buckets mounted on it would peel the oil sands from the face being worked and would deposit the material on the primary conveying arm. From this arm the material would be transferred to a second arm which would convey it to the next phase of the conveyor system.

The wheel proposed would be approximately 22 feet in diameter, with 9 buckets each of 0.9 of a cubic yard capacity, and would be designed to dig oil sands at a rate of some 115,000 tons per day. This design capacity is much in excess of the 65,780 tons per day required to produce the 31,500 barrels per day of synthetic crude oil.

The excavator is said to be capable of mining a bank approximately 65 feet high from the bench on which the conveyor rests or a bank 30 feet high while located on the bench below the conveyor. It would mine a bank approximately 114 feet wide, perpendicular to the conveyor line, with each pass of the bench. The use of a belt wagon would permit the mining of a second bank of 114 feet width on the return run before moving from the conveyor bench to the lower bench, or moving from the lower bench to the conveyor bench, and thus would minimize time lost in moving or extending the conveyor systems.

(b) Shiftable Conveyor System:

All major field belt conveyors would be 54 inches wide and would operate at 1,000 feet per minute. The structure supporting these conveyors would be set on railway ties so that it could be moved by means of a special track shifter. In the operation of digging the oil sands, there would be independent secondary oil sands conveying systems at each level for transferring the material to the main conveyor. Each conveyor would be designed to take the peak theoretical capacity of a digging machine and transport the material away from the mining area. Similarly, the conveyors supplying the stacking machines would be geared to the peak theoretical capacity of the stacker and would be capable of handling the tailings from the extraction plant.

(c) Crawler-mounted Stacker:

Basically a tailings and overburden spreader, this machine would consist of a hopper and a series of belt conveyors. The material to be dispersed would be deposited on a conveying arm of the stacker and carried to a central transfer hopper where it would be shifted to a second conveying arm. This arm or boom would be approximately 170 feet long and as a result would lend itself to selective placement of waste over the ground.

2. Separation of the Oil from the Oil Sands

The process proposed for the extraction of the oil from the oil sands is that originally developed by Dr. K. A. Clark of the Research Council of Alberta and known generally as the "Hot Water Separation Process". This method of extraction was pilot tested under Dr. Clark's supervision at the Government of Alberta Bitumount Pilot Plant. The process is based upon the simple fact that a gross separation of the oil and the sand takes place rather readily when the oil sands are agitated in hot water. Complications arise due to the incompleteness of the separation - mainly the contamination of the oil with fine mineral matter, clay and water. Closely associated with the basic extraction process are operations for the deaeration of the oil froth produced in the hot water process and dehydration of the deaerated froth.

A schematic flow sheet of the hot water separation process, as Great Canadian proposes to use it, appears as Figure 2. This figure also shows the design capacities of the equipment. The overall capacity would be some 88,000 tons per day of oil sands as compared with the 65,780 tons per day required to yield 31,500 barrels per day of synthetic crude oil and as shown in Figure 1. Limitations of equipment size would require the use of eight complete trains of equipment, each train designed for 11,000 tons per day. An outline of the process follows:

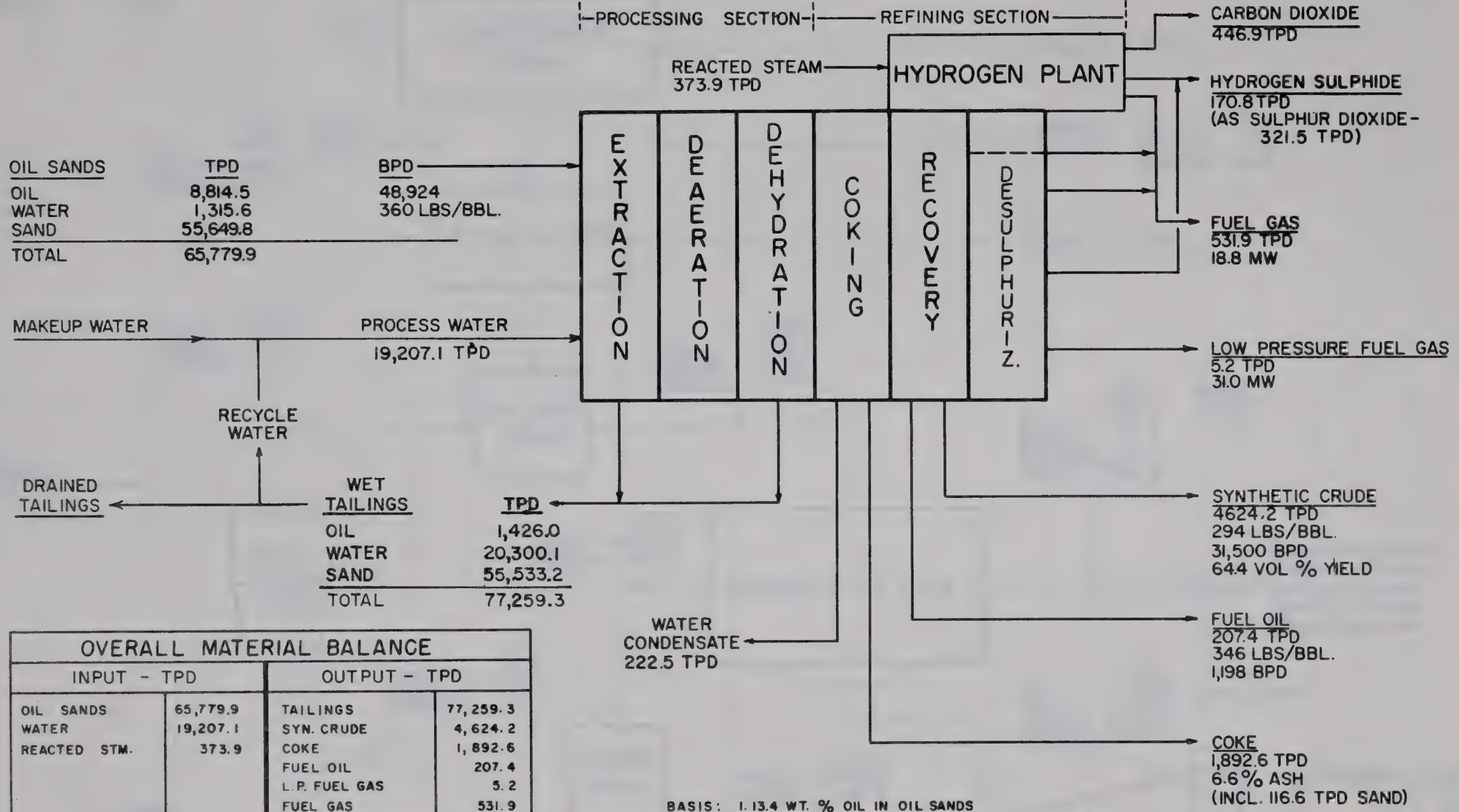
Oil sand feed would be conveyed to a rotary conditioning drum where it would be conditioned with regard to water content and temperature. The temperature of the oil sand feed is estimated at 39 degrees Fahrenheit. The average feed would have a water content of 2 per cent and would contain 13.4 per cent oil by weight. Water at 185 degrees Fahrenheit and steam would be added to raise the sand temperature and assist the breaking down of sand lumps into a fine dispersed state. At the discharge end of the conditioner screening bars would remove stones, wood and large sand or clay lumps from the mixture.

The conditioned mixture of water, sand and oil would be conveyed directly into a special mixer which would serve to wet each individual sand particle with water and to froth the oil with air. The mixer would be designed to produce

FIGURE I

SCHEMATIC FLOW SHEET AND MATERIAL BALANCE PROCESS PROPOSED BY GREAT CANADIAN OIL SANDS LTD.

(FLOW SHEET SUBMITTED BY APPLICANT)
(QUANTITIES SHOWN ON PROPOSED THROUGHPUT BASIS)
OIL AND GAS CONSERVATION BOARD
OCTOBER 14, 1960



OVERALL MATERIAL BALANCE

INPUT - TPD		OUTPUT - TPD	
OIL SANDS	65,779.9	TAILINGS	77,259.3
WATER	19,207.1	SYN. CRUDE	4,624.2
REACTED STM.	373.9	COKE	1,892.6
		FUEL OIL	207.4
		L.P. FUEL GAS	5.2
		FUEL GAS	531.9
		HYDROGEN SULPHIDE	170.8
		CARBON DIOXIDE	446.9
		CONDENSATE	222.6
TOTAL	85,360.9	TOTAL	85,360.9

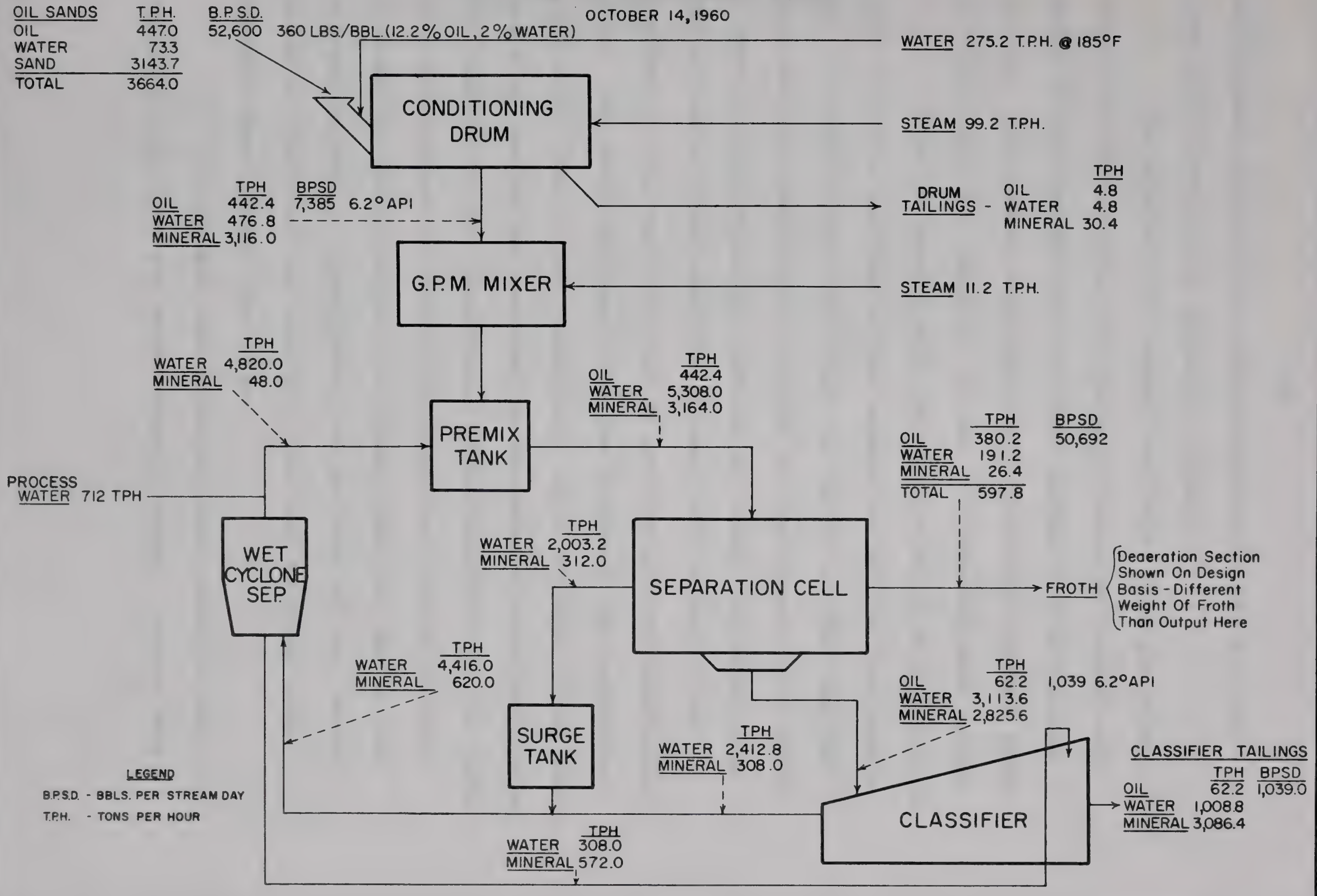
BASIS:
1. 13.4 WT. % OIL IN OIL SANDS
2. 85 VOL. % OIL RECOVERY IN EXTRACTION UNIT
3. 99 VOL % OIL RECOVERY IN DEHYDRATION UNIT
4. PROCESS STEAM NOT INCLUDED

TPD: TONS PER DAY
BPD: BARRELS PER DAY

FIGURE 2

DETAIL SCHEMATIC FLOW SHEET EXTRACTION SECTION PROCESS PROPOSED BY GREAT CANADIAN OIL SANDS LTD.

(QUANTITIES SHOWN ON DESIGN BASIS)
OIL AND GAS CONSERVATION BOARD
OCTOBER 14, 1960



an intimate mixing of the water and mineral and to introduce sufficient air to produce a froth.

The aerated oil, mineral and water from the mixer would flow to a premix tank where it would be flooded with water at 185 degrees Fahrenheit to produce a free flowing slurry. The premix tank would be fitted with a paddle mixer to facilitate the "washing" of the oil from the sand grains.

From the premix tank the mixture would be distributed onto the water surface of the separation cell at its centre. The oil-water froth would float to the top of the tank and sand and some water would collect at the bottom of the tank. A rake assembly would be provided to assist the separation. The oil-water froth would be skimmed off the top of the separation cell and then flow by gravity into the deaeration tank. The water and sand from the bottom of the separation cell would flow to the classifiers where the bulk of the water would be removed and returned to the water circulation system. The classifiers are essentially dewatering devices, but would also be designed to recover hot water and recycle it back through the hydro-cyclones and premix tank for use in the separation cell. Approximately 80 per cent of the water would be recovered and re-used. The sand tailings would contain about 25 per cent water.

It is proposed that hydro-cyclones would be used to remove solids from the water recycle stream. Excess water and fines drawn off the side of the separation cell would enter a surge tank and then join the water separated from the sand by the classifiers. These combined streams would enter the hydro-cyclones where much of the fine material would be removed and returned to the classifiers, allowing water to be re-used in the process.

To condition the oil froth for preliminary refining it is necessary that it be deaerated and dehydrated. A schematic flow sheet covering these operations is given in Figure 3. The deaeration equipment would be overdesigned and capable of producing some 60,400 barrels per day of deaerated oil. Similarly the dehydration unit would be capable of producing some 46,000 barrels per day of dehydrated oil.

The froth entering the deaeration section from the separation cell normally would consist of about 65 per cent by weight of clean oil with a gravity of 6.2 degrees API, 30 per cent by weight of water and 5 per cent by weight of mineral. In the deaerator live steam would be injected below the liquid level, raising the temperature of the froth to 212 degrees Fahrenheit and stripping the air from the froth. A mixer would be employed in the vessel to disperse the steam and to improve the liberation of air. The steam and released air would be removed from the top of the unit and the deaerated froth would be pumped to storage prior to being fed to the dehydration equipment.

FIGURE 3

SCHEMATIC FLOW SHEET

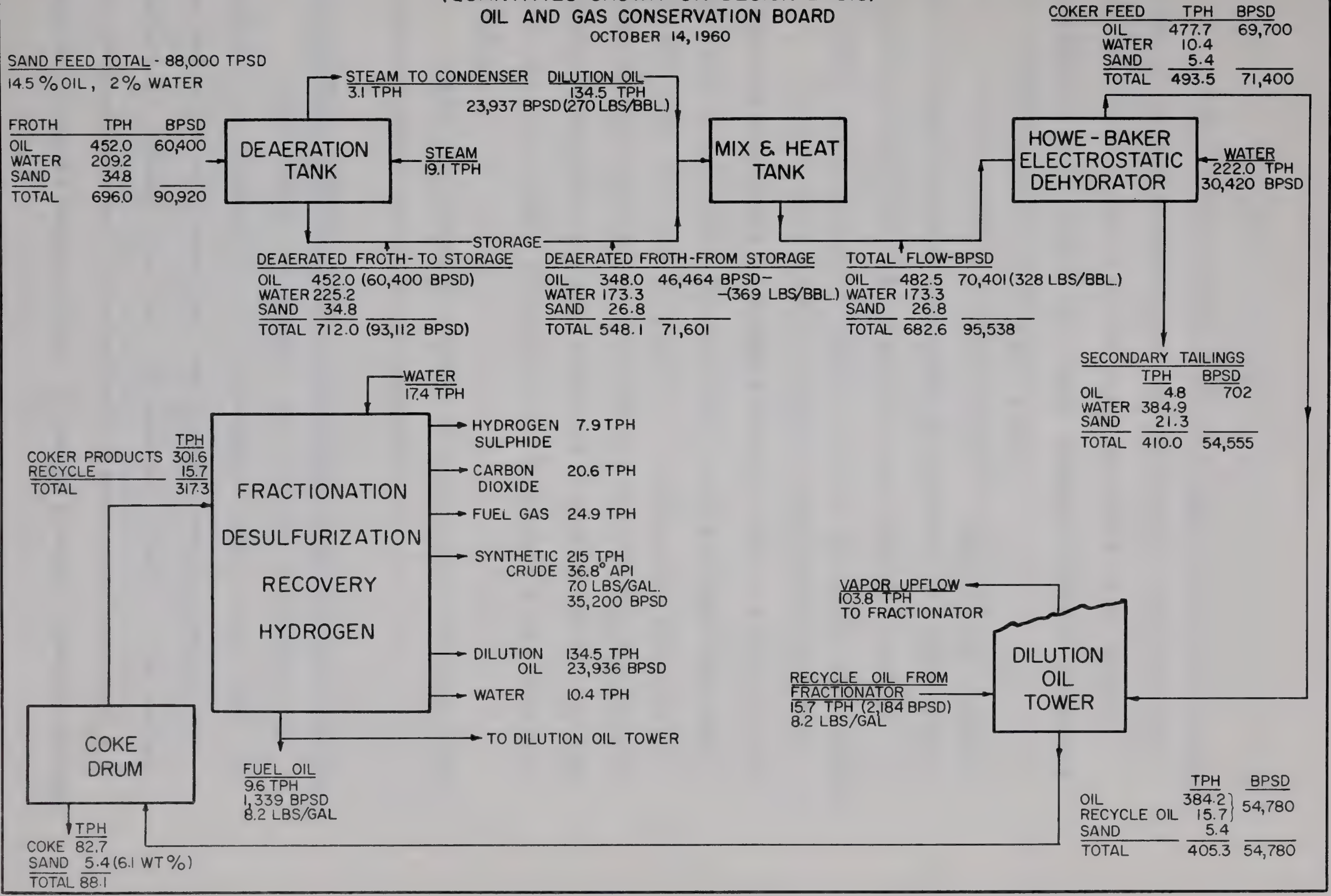
DEAERATION, DEHYDRATION AND REFINING SECTION

PROCESS PROPOSED BY GREAT CANADIAN OIL SANDS LTD.

(QUANTITIES SHOWN ON DESIGN BASIS)

OIL AND GAS CONSERVATION BOARD

OCTOBER 14, 1960



The deaerated froth would be pumped from the storage tanks to a diluent mixing and heating tank. In this tank the deaerated froth would be mixed with hot (420 degrees Fahrenheit) 51.9 degree API coker gasoline diluent resulting in a blended oil of 18.9 degrees API.

Electrostatic treaters would be employed to separate the oil from the water and most of the remaining sand. This separation would be made easier by the dilution of the deaerated froth and the reduction of its viscosity and density.

In the electrostatic treater, dehydration and demineralization would be accomplished by means of a high voltage field which would coalesce the water particles causing the sand and water to drop out. It is expected that this treater would recover at least 99 per cent of the hydrocarbon charge, reduce the solids content by a minimum of 80 per cent and reduce the water content to not more than 2 per cent by volume.

The waste products would be discharged from the bottom of the treaters and sent to disposal.

3. Preliminary Refining of the Oil to Yield a Synthetic Crude Oil

Preliminary refining of the diluted dehydrated oil sand oil is proposed for the recovery of the diluent and for the reduction of viscosity, the improvement of gravity and removal of sulphur from the oil sand oil itself. The refining process proposed is relatively conventional and does not require detailed description. It would involve delayed coking, fractionation and hydrogen desulphurization. The latter operation would require that hydrogen gas be generated. A simplified block diagram of the refining operations is included as part of Figure 3.

The delayed coking unit has been designed to process some 54,780 barrels per day of the diluted dehydrated oil sand oil obtained from the dehydration unit described earlier. In conjunction with the delayed coking unit, equipment is proposed for light hydrocarbon recovery from the net coker products, the unstabilized naphtha and the desulphurizer fractionator feed flash vapour.

The principal product from the delayed coking unit, naphtha and gas-oil distillates, must have their sulphur and nitrogen contents reduced considerably in order to meet product specifications. This would be done in high pressure reactors with hydrogen-rich gas generated in the hydrogen unit.

The hydrogen unit would utilize coker tail gas and the pressure steam reforming process to produce 31,000,000 standard cubic feet per stream day of hydrogen from hydrocarbons.

The overall products of the preliminary refining operation would include the synthetic crude oil, coke, fuel gas, hydrogen sulphide and carbon dioxide gas and the recovered dilution oil. The design capacity of the refining facilities is some 35,200 barrels per day of synthetic crude oil as compared with the 31,500 barrels per day proposed operating level.

4. Waste Disposal

(a) Solid Wastes:

(i) Mining Wastes.

The applicant expects that it would be necessary to discard only minor quantities of oil sands in conjunction with rejected plant feed. It is anticipated, on the basis of core work, and consideration of the method of digging, that less than 5 per cent of the material to be worked would contain fines resulting in average oil losses of greater than 5 per cent in the separation process. Rejected material, including lean oil sands, would be disposed of in a solids disposal area near the quarry during the initial period of operations.

(ii) Tailings.

There would be three tailings streams which would carry solid wastes from the process.

Approximately 1 per cent of the oil sand feed, or approximately 20 tons per day, is expected to be lost with screenings from th outlet of the rotary conditioner. The screenings, however, would be mostly stones, pieces of wood or large unconditioned sand or clay lumps.

The major tailings stream carrying some 98 per cent of the solid tailings wastes would come from the classifiers. This stream would consist largely of water and mineral. The sand and clay mineral would contain approximately 25 per cent water. There would be an oil loss in these tailings estimated not to exceed 15 per cent of the oil in the plant feed. The designer expects actual losses of less than 5 per cent at this point in the process.

The third tailings stream would be from the electrostatic dehydrators and would be largely water with small amounts of fine sand and oil. Losses of oil would amount to 1 per cent of the original plant oil feed.

The combined tailings stream from all three sources would discharge a maximum of 1,400 tons or 8,000 barrels per day of oil, 56,000 tons per day of minerals (mostly sand and clay) and 114,000 barrels of water. The latter would, for the most part, be recycled to the plant. It should be emphasized that the expected oil loss would be much less than the maximum and in the order of 3,000 barrels per day. The preceding figures are based upon an average synthetic crude production of 31,500 barrels per day.

Initially tailings would be disposed of hydraulically to an area south of the plant. The sand tailings from the classifiers in the extraction plant would leave the buildings on a belt conveyor. At a point just beyond the wall of the building a tripper would be provided which would discharge the tailings during normal operation from the belt into a slurry sump located directly below the tripper.

The sump would consist of a concrete flume with the recycle and make-up water entering at one end and the slurry pumps taking the slurry mixture at the other end. As the water flows through the flume the tailings would be introduced into the stream along with the blowdown from the dehydration unit. The slurry mixture consisting of approximately 40 weight per cent water would then enter the suction manifold of the pumps. The flume would be provided with an emergency overflow into the storm sewer system.

Should an unscheduled shut-down of the hydraulic conveying system occur, the tailings from the extraction plant would by-pass the tripper and be discharged from the end of the conveyor and form an emergency tailings pile.

From the slurry sump the slurry would be pumped through an 8,000 foot discharge line to the northern portion of the initial disposal area. This line would be above ground and insulated and a closed in shelter would be provided for the pumps and valves. The discharge line would terminate in a sluice box from the outlet of which an open wooden flume would extend 200 feet further into the disposal area. The flume and end of the slurry line would be supported by a trestle which would place the discharge from each of the three alternate sluiceways at least 50 feet above the grade of the ground below.

A concrete sump would be located near the low point of the initial disposal area to serve as a collecting point for the run-off from the tailings pile. The design of this sump would, if considered desirable, include provisions for the addition of equipment to skim any accumulation of oil from the surface of the recycle water in the sump.

A pipe line 12,000 feet in length and pumps capable of handling 12,000 gallons per minute would be provided for the recycle of water to the slurry sump. Make-up water for the system would be taken from the hot water return of the cooling water system and introduced into the slurry sump by a level controller.

After a period of approximately three years, a conveyor system would be provided for returning the sand tailings to the mined out area for disposal by a stacking machine. The bulk of the water would be removed at the plant site before the sand tailings reach the conveyor system.

(iii) Coke.

Approximately 1,900 tons of coke would be removed hydraulically from the coke drums each day. The larger particles held on a screen would be conveyed to the boiler plant where they would be pulverized and used as fuel. The excess coke, amounting to approximately 900 tons per day, would be disposed to the tailings area.

The water from the coke drum cleaning process plus any smaller coke particles which pass through the screen would be pumped and would join the tailings from the dehydration section.

(b) Water Wastes:

Condenser effluent and natural precipitation free from contamination, would be carried directly to the river by an open ditch.

The oily water wastes from the plant area would be carried in a buried sewer system to a large rectangular baffled separator which would separate the oil from the water. Any oil collected at this separator would be pumped to a slop tank for further treatment or disposal. If, for any reason, the separation of oil and water were incomplete, the water would be sent to a large holding basin where further treatment would occur before the water would be discharged to the river. Otherwise, the water from the separator would by-pass the holding basin and would be sent to a smaller by-pass basin on the way to the river. Oil settling out in the holding basin would be pumped to the slop tanks.

Hot water effluent from the hydrocarbon heat exchangers would normally be clean and would pass only through the holding basin on the way to the river. In the event of a tube failure in an exchanger the water would be contaminated with hydrocarbon and would normally be routed through the separator. For average flow conditions where 500 gallons per minute from the oily water sewer pass through the separator, contaminated hot water effluent at average rates of 3,000 gallons per minute could safely be diverted to the separator as well.

Two pits, each approximately 30 feet square, would be provided to handle the water and sludge which would accumulate from the back flushing of the filters used in the boiler feed water treatment. While one sludge pit would be filling the other would be drained and cleaned out. The sludge would be scooped out and hauled to a disposal area.

Sanitary sewage would be disposed through septic tanks and effluent filter beds adjacent to the sewage source on the plant site. No central sewage treatment facilities would be provided. A small amount of septic tank effluent from unit areas would discharge to the oily water sewer.

(c) Gaseous Wastes:

The gaseous wastes would include some 300 tons per day of sulphur (appearing in the form of 3.9 million cubic feet per day of sulphur dioxide) and 7.5 million cubic feet per day of carbon dioxide. The sulphur dioxide would enter the atmosphere from the top of a 300 foot high incinerator stack. The carbon dioxide would be vented to the atmosphere at an unspecified point in the plant area.

A gas disposal manifold would be constructed to collect gas from vent lines and relief valves in the process units. The manifold would connect to a liquid knock-out drum which in turn would be connected to a 250 foot high derrick supported flare stack. The stack would be located at a high elevation distant from hazardous areas and would be equipped with pilot and ignition controls.

5. Pipe Line Transportation of the Synthetic Crude Oil to Edmonton

The proposed sixteen-inch diameter pipe line to Edmonton would be approximately 290 miles in length. For the first 20 miles the pipe line would run parallel to the access road which is to be constructed along the west bank of the Athabasca River from McMurray to the plant site. At McMurray the pipe line would cross the river on a bridge to be constructed by the applicant.

This structure would consist of six steel approach spans totalling 550 linear feet and a steel truss bridge 1,324 feet long from which the pipe would be suspended. The bridge would be designed to handle vehicle traffic and would provide sufficient clearance for river traffic underneath the centre span.

At Waterways, immediately south-east of McMurray, the pipe line would begin to follow the Northern Alberta

Railway and would continue to do so until it reaches Lac La Biche. Here the railway begins to deviate and the pipe line would take a fairly direct course for the remaining one hundred miles to a point north-east of Edmonton where it would make a submerged crossing of the North Saskatchewan River to tie into the Interprovincial pipe line terminal. Details of the route of the proposed pipe line are shown in Figures 4 and 5.

At an average flowing temperature of 45 degrees Fahrenheit the line would be capable of handling 36,000 barrels of synthetic crude oil per day without any intermediate pumping stations. Depending on the ambient temperature fluctuations during winter and summer, the pipe line capacity would vary between 36,000 barrels per day and the guaranteed minimum throughput of 32,000 barrels per day. Provision would be made in the valve installations during initial construction for the addition of three future pumping stations which would increase the line capacity to 110,000 barrels of product per day.

Marketing of the Synthetic Crude Oil

As a provision of the draft agreement between the applicant and Sun Oil Company, Abasand Oils Limited and Canadian Oil Companies, Limited, Sun Oil Company and Canadian Oil Companies, Limited, agreed to purchase a daily average of 20,000 barrels per day of synthetic crude oil meeting certain minimum specifications as set out in the draft agreement.

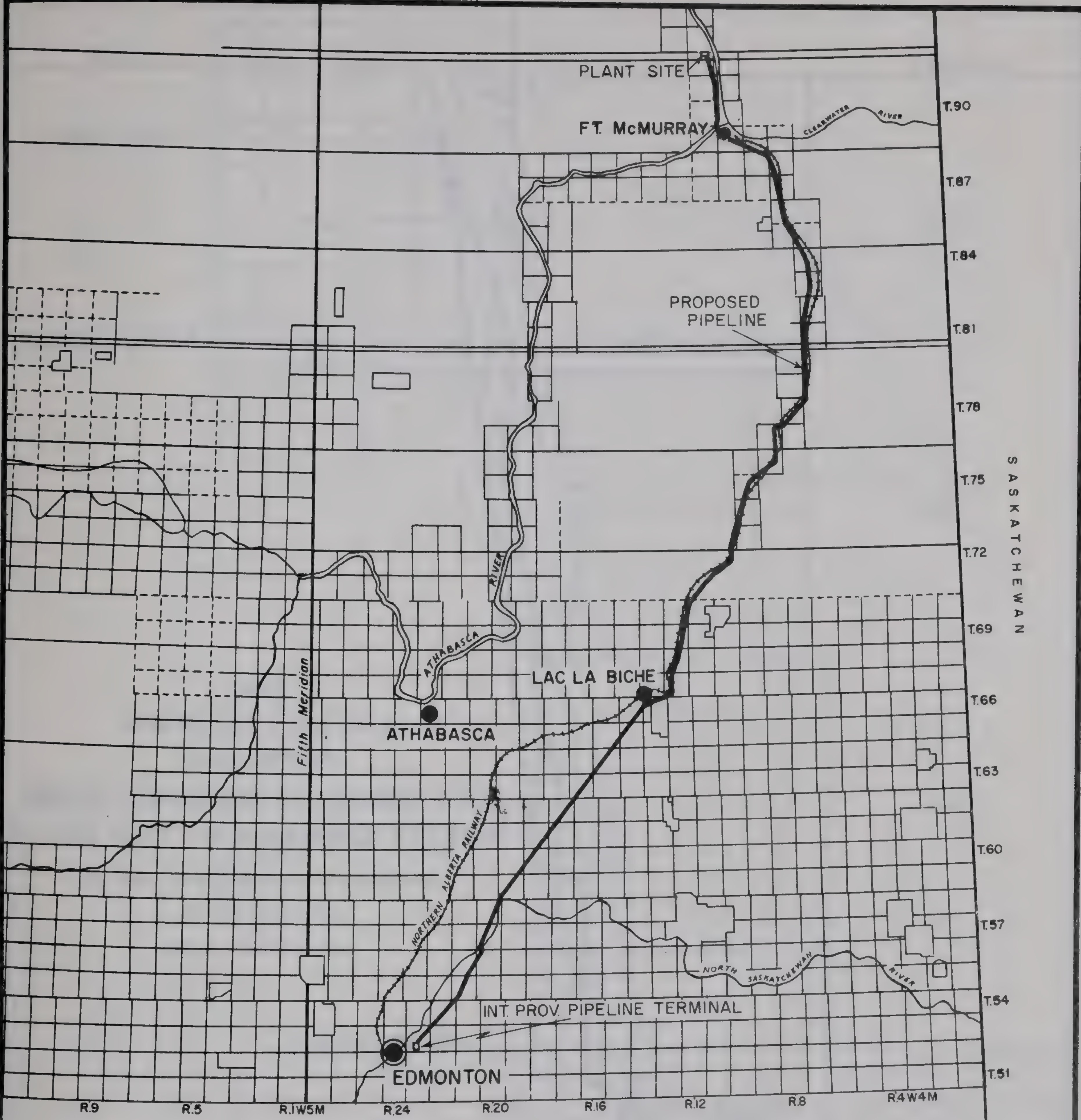


FIGURE 4

ROUTE OF PIPELINE
PROPOSED BY
GREAT CANADIAN OIL SANDS LTD

OIL AND GAS CONSERVATION BOARD
OCTOBER 14, 1960

SCALE: 1 inch = 35 miles

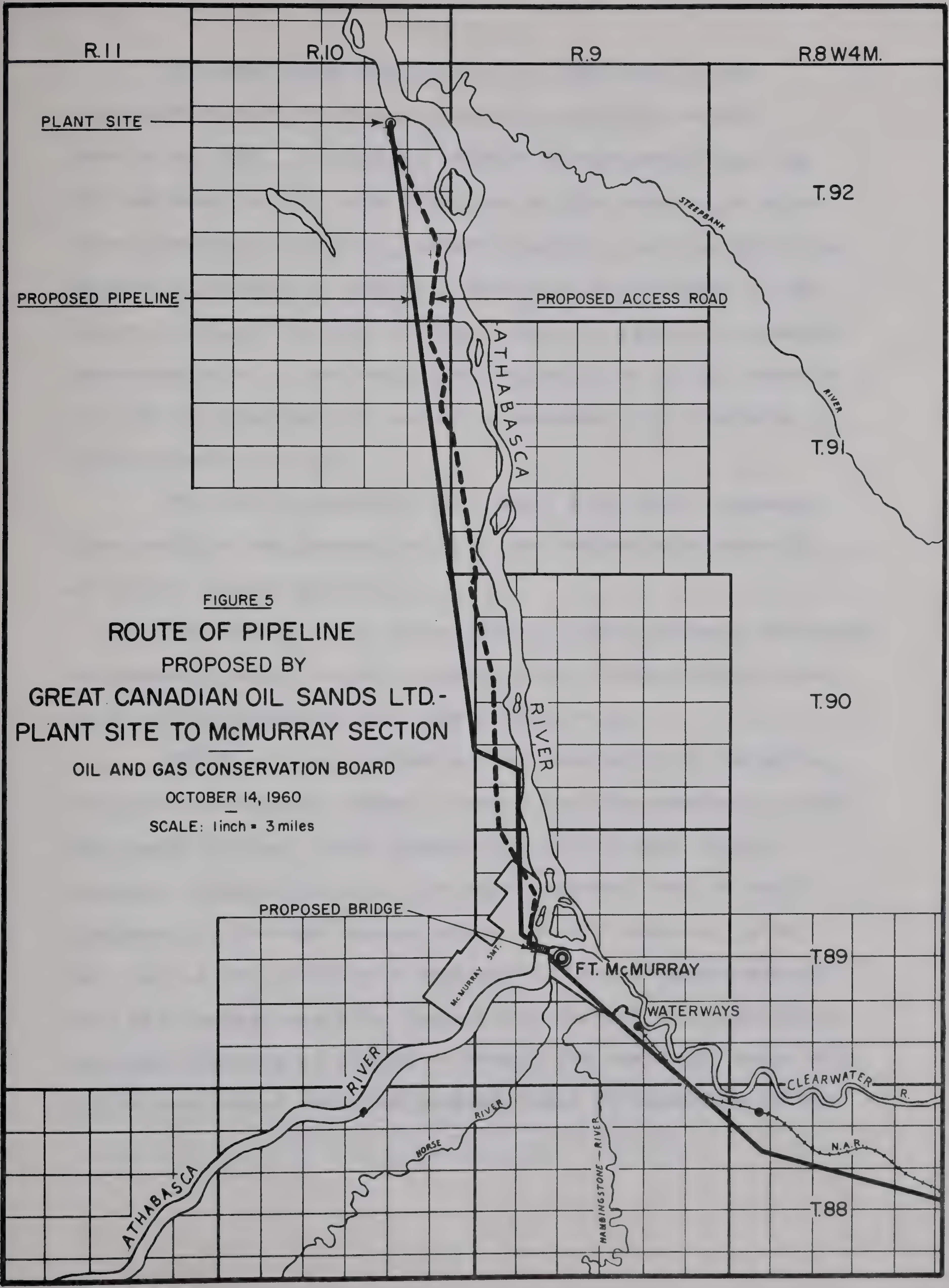


FIGURE 5

ROUTE OF PIPELINE
PROPOSED BY
GREAT CANADIAN OIL SANDS LTD.-
PLANT SITE TO McMURRAY SECTION

OIL AND GAS CONSERVATION BOARD
OCTOBER 14, 1960
SCALE: 1inch = 3miles

This agreement was drafted in 1958 when it was contemplated that the plant production would be 20,000 barrels per day. Subsequent letters of agreement from Sun Oil and Canadian Oil were submitted at the hearing in which these companies agreed to purchase the full contemplated production of synthetic crude oil delivered at Edmonton in the amount of 31,500 barrels per day. Sun Oil agreed to purchase three-quarters of the production amounting to 23,700 barrels per day and Canadian Oil agreed to purchase the remaining 7,800 barrels per day.

The draft agreement also would give these companies first call on any production over the contemplated capacity of 31,500 barrels per day.

The agreed price to be paid for this product, delivered at Edmonton, would be the current price in Edmonton of Leduc crude oil in effect at the time of delivery.

While giving evidence at the hearing D. W. Ferguson, President of Sun Oil Company, stated that the synthetic crude oil would displace other Canadian crude oil used in the company's Sarnia refinery. He also expected that it would displace its foreign imports which in 1959 amounted to 28 per cent of its refinery's throughput. Mr. Ferguson stated that the company would be required to install some additional refining capacity at Sarnia to handle the synthetic crude oil, but he considered that the company would be expanding in any event to take care of the normal growth in demand for refined products. He also intimated that there might be some crude oil movement from Sarnia in their refinery at Toledo in the future. Mr. Ferguson appeared confident that his company would have no difficulty in taking delivery of the 23,700 barrels of plant production when it became available.

Mr. W. M. Luthy, Manager of the Production Department of Canadian Oil Companies, Limited, also gave testimony at the hearing with respect to the agreement by his company to purchase 7,800 barrels per day of synthetic crude oil. Mr. Luthy was confident that this amount of plant production could be absorbed in the company's Sarnia refinery by the normal growth in demand and none of the present requirements for crude oil from Alberta would have to be cut back. He stated that Canadian Oil's Sarnia refinery has a capacity of 50,000 barrels per day and the present throughput is only 30,000 to 35,000 barrels per day. All of its allotment of the synthetic crude oil would be processed in the Sarnia plant.

Apart from the synthetic crude oil no other plant products are considered saleable by Great Canadian.

7. Method of Financing

The application of Great Canadian indicates that Fry and Company Limited would be responsible for completing financing arrangements. Mr. J. D. Wilkins, who is President of both Great Canadian and the investment firm of Fry and

Company Limited, appeared before the Board to outline financing details. He advised that these plans had not yet been completed but that Great Canadian expects to raise approximately $110,000,000, of which $45,000,000 would be by mortgage bonds, $45,000,000 by debentures with stock options and $20,000,000 by equity stock. As far as possible the funds would be obtained in the Canadian capital market, but in view of the large amount involved Mr. Wilkins considered that it would be necessary to approach the London and perhaps the New York capital markets.

In its application and in Mr. T. P. Clarke's direct testimony, Great Canadian emphasized that residents of Alberta would have an opportunity to purchase securities in this venture. With regard to the question of equity stock, Mr. Wilkins advised that in the prospectus of Great Canadian, reference is made to two options for the purchase of shares. One of these options is in favour of Mr. Clarke, Managing Director, while the other is in favour of directors and officers of the company, financial institutions and investment dealers. The purchase price for shares covered by these options is $3.00 per share.

In discussing the feasibility of underwriting a venture of this magnitude, Mr. Wilkins indicated that "the question of raising capital is predicated upon the rate of return on the investment which is made, and based upon the economics which have been prepared by Universal Oil Products set against the capital cost, we feel financing is practical and possible". He also stated that one of the prime considerations is the speed with which the capital investment can be recovered. He indicated that if the period were as long as ten years it would be impossible to obtain the necessary funds. The application of Great Canadian contemplates a five-year payout period. Under examination, Mr. Wilkins added that he would not like to see the period extended beyond six years and that if it were the financing would become "very chancy".

V

APPRAISAL OF THE PROPOSAL

1. Recovery and Conservation

(a) Oil Sands:

An analysis of the core drilling performed by the Dominion Government and by the applicant is reported to indicate a total reserve for Lease No. 4 of approximately 900,000,000 barrels of oil when considering only those sands containing 10 per cent oil or higher.

The guaranteed amount of synthetic crude oil which would be recovered from this feed material is approximately 64 per cent by volume. This overall recovery is based on the estimated maximum losses of 15 per cent of the oil sand feed during the extraction phase, 1 per cent during the dehydration phase and a further 24 per cent reduction in volume during the refining of the oil. However, because of the higher efficiencies expected in the extraction and refining phases of the operation, the applicant contends that the overall recovery should approach 74 per cent.

Details of the minimum and expected recoveries for the various phases of the process follow:

	Assumed Av. Dry Crude In B.P.S.D.	Av. Dry Crude Out B.P.S.D.	Minimum Expected Recovery Per Cent	Actual Expected Plant Recovery Per Cent	Expected Cumul. Recovery to this Point Per Cent	Average API Gravity of Crude Oil
Extraction	48,900	41,600	85	95	93	6.2
Deaeration	41,600	41,600	100	100	88	6.2
Dehydration	41,600	41,200	99	99	88	18.9
Refining	41,200	31,500	76	79	87	36.8
Overall Recovery			64	74	69	

Assuming an oil loss in the plant of 26 per cent and a further loss of 7 per cent for exclusion of lean sands and diking during the mining operation, the total recoverable oil from Lease No. 4 would be in the order of 600,000,000 barrels. The Board considers such a recovery to be satisfactory.

(b) By-Products:

Approximately 900 tons per day of coke would be produced in excess of plant fuel requirements. This excess is slated for disposal in the mined out area. It is conceivable that should this coke be stacked some would be marketable.

Similarly, since approximately 300 tons per day of sulphur in the form of sulphur dioxide would be blown into the air, the installation of facilities for the recovery and subsequent sale of sulphur may have economic possibilities. At any rate, such a conversion may be the only feasible means of preventing excessive contamination of the area around the plant.

2. Technical Feasibility

During the hearing of the application, the interveners, the Board staff and the Board raised certain questions concerning the technical feasibility of certain steps of the proposed process and integrated operation. These matters are discussed in the following:

(a) Mining and Conveying:

Representatives for Cities Service Athabasca, Inc., contend that the oil sands cannot safely support heavy mining equipment. The oil sands when exposed to above freezing temperatures undergo a gradual reduction in strength which is accentuated by the passage of equipment. Further, experience has indicated to Cities Service that comparatively soft pockets are encountered in the body of the sand at Mildred Lake and that during warm periods the oil sands deteriorate rapidly. For these reasons it was concluded by Dr. R. M. Hardy, a soils mechanics expert retained by Cities Service, that an excavator cannot be satisfactorily operated from a bench located on the oil sands face.

Dr. K. A. Clark of the Research Council of Alberta, an oil sands authority appearing for Great Canadian, and Mr. T. P. Clarke, Managing Director of Great Canadian, responded to several queries by the interveners regarding the bearing pressure exerted by equipment proposed by the applicant for use in the mining operation. They gave evidence to the effect that the bearing strength exhibited by oil sands at the Bitumount plant site is more than adequate to support equipment having bearing pressures several times greater than the proposed mining equipment. Dr. Clark in direct rebuttal of Dr. Hardy's testimony contended that the difficulties encountered by Cities Service in moving heavy equipment over the oil sands were due to the locally disturbed condition of the oil sands body they are working. He said the properties exhibited by this disturbed material cannot be interpreted as being representative of the oil sands in the main body that Great Canadian is going to mine.

The Board believes that there is a definite possibility that the conditions which prevail or the problems expected regarding the bearing strenght of the oil sands on the Cities Service site may be encountered on Great Canadian Lease No. 4. It is recognized, however, that it would be possible to meet such a situation in various ways by distributing the weight of the equipment over a greater area.

Representatives for Cities Service stated that a considerably greater number of limestone boulders were encountered on its lease than was indicated by core drilling and that occurrences of similar material would be encountered on Lease No. 4. It was also stressed that the shearing resistance of the oil sands indicated by pilot tests was considerably less than that found to exist during the actual digging operations and that more power would be necessary in a commercial mining operation than previously anticipated by the Cities Service technical group. It was their contention that Great Canadian does not appreciate the significance of these problems and have not made adequate provision to solve them.

While commenting on these statements, Dr. K. A. Clark said that the mixing of limestone boulders with the oil sands is to be expected in an area where the oil sands have been disturbed. He believes that this condition does not exist on Lease No. 4.

The applicant did not conduct extensive tests on the shearing resistance of the sands on Lease No. 4. There is, therefore, a good possibility that the proposed digging machines would be underpowered, at least for the severest conditions which could be encountered. The Board recognizes, however, that provision has been made for light blasting when streaks of boulders occur or cold weather makes it necessary. When lean sand is encountered the flexibility offered by a standby digger, alternate mining bench and a core hole program should facilitate the mining operation and permit the unrestricted flow of oil sand feed to the plant.

The belt conveying system would be designed to carry the peak theoretical capacities of the digger and stacker and the design has not been seriously questioned.

(b) Oil Sands Processing:

It was stated by an intervener that no provision is made for reducing the particle size of the feed to the rotary conditioner. Mr. T. P. Clarke pointed out that such equipment was likely unnecessary since a scalping device on the excavator would remove lumps larger than 20 inches from the oil sands before they reached the conveying system.

The conditioner would either break up any remaining lumps or reject them at the outlet screen. If necessary some means could be provided for crushing the rejected lumps. The Board does not consider this to be a serious problem.

The interveners believe that although a method is provided for removing the fines from the recirculation water the method proposed is unproven and a build-up of fines could occur which would make separation of the oil froth impossible. Mr. G. R. Coulson, a director of Can-Amera Oil Sands Development Ltd., an intervener, was particularly strong in his emphasis on this point. He stated that the proposed method of fines removal would meet with failure.

Mr. R. H. Jebens, on behalf of Patterson Foundry and Machine Company, who is responsible for the extraction process, stated during questioning that the separation process as proposed by Patterson would work satisfactorily and that 95 per cent of the oil in the oil sand feed would be recovered. With hydrocyclones incorporated into the water recirculation stream, the material coarser than clay would be removed. The witness stated further that experiments have proven that the clay content in the recirculation water stabilizes before reaching the critical level at which separation is impeded in the separation cell. He also said that the occluded water in the sand tailings would remove 90 per cent of the fines with it, while the remaining 10 per cent would leave with the oil froth.

The Board is not completely satisfied with the dismissal of the problem by Patterson and believes that the build-up of fines could cause serious problems.

Mr. G. R. Coulson, as intervener, expressed further doubt concerning the proposed process. He stated that substantial losses of oil could occur in the settling at the electrostatic precipitators. After the froth has been mixed with diluent and heated, the clay particles carried over from the separation tank would become oil wet. This would mean that coagulant would fall out through the water layer carrying oil and diluent with it. Mr. Coulson contended that this oil and diluent would be lost unless recovered through another operation such as the one developed by himself and owned by Can-Amera Oil Sands Development Ltd. Clay particles not precipitated in the electrostatic treater would be deposited on the coke in the coker unit and would lower its quality as a fuel.

A representative of Howe-Baker Engineers Inc., H. Black, appearing on behalf of Great Canadian, gave evidence that if the hydrocarbon charge to the electrostatic precipitators supplied by his company met the specifications (stated in part as a diluted froth mixture of approximately 30 per cent water, 5 per cent mineral and 65 per cent clean oil) a minimum of 95 per cent of the hydrocarbon charge would be recovered. He stated also that this recovery figure is in no way dependent on the particle size or composition of the mineral matter. Mr. Black of Howe-Baker contended that the fines in the electrostatic precipitators are water wet and stated that he is convinced that the proposed equipment would maintain a high level of separation, as verified by his experiments.

The Board is inclined to accept the views expressed by Howe-Baker.

Can-Amera raised the question of the minimum metal content required by Universal Oil Products in the feed to the unifining unit for desulphurization, for which Universal would be directly responsible. The intervener stated that vanadium and other trace metals could be present in the diluted oil reaching the desulphurization section in high enough concentrations to cause poisoning of the catalysts and increased catalyst consumption.

As prime contractor for the proposal and responsible for this phase of the operation, Kellogg representatives denied that trace metal concentrations would be of any consequence and said that most of the metal would remain with the coke in the coking unit.

The Board believes that as long as the coking unit is properly designed and operated, little non-volatile material should find its way to the desulphurization unit.

At various times during the hearing of the application the interveners questioned the nature and shortage of pilot plant tests for the proposed process. Since the process, particularly the oil extraction phase, has not been tested on an integrated basis, operational problems could arise which are not apparent at the present time. In addition, the opinion was expressed on different occasions that the amounts and quality of the material used in the testing of certain equipment did not provide a sound basis for predicting the performance in a commercial operation. Mr. A. F. Frame, President of Cities Service Athabasca, Inc., was strong in his opinion that the present proposal was based on an inadequate research program.

Mr. T. P. Clarke and other witnesses for Great Canadian denied this and went on to say that batch testing would provide adequate information for the design of a commercial plant. In 1959 hot water separation tests were run at the request of M. W. Kellogg on thirty to forty pound batches of Lease No. 4 oil sands. Operations were carried out in Edmonton with the assistance of the Research Council of Alberta and Dr. K. A. Clark. Present also were representatives of Patterson and Great Canadian. Pilot equipment used included a mixer, heater and separation cell. The conclusion was that the separation equipment proposed by Patterson for extraction of oil from oil sands would do the job well.

A representative of Patterson stated that although tests were run on a non-continuous basis, it was his opinion that batch treatment has advantages in that one could obtain exact compositions of the material to be studied. In testing the extraction equipment the composition of the feed was controlled in order to determine the effects of varying proportions of clay and other mineral matter. In other tests an effort was made to duplicate the actual composition of the oil sands as indicated by core samples.

It was stated by a representative of Kellogg, in regard to the question of pilot plant studies, that Kellogg had run tests on its deaeration equipment in New Jersey. The deaeration experiments were done in batches of about 400 milliliters (about one pint) on oil froth produced in conjunction with extraction experiments conducted at the Research Council of Alberta.

In addition, 90 gallons of oil froth were sent to Howe-Baker in Texas and this froth was processed in a two barrel per hour pilot unit for a period of three eight-hour shifts.

Some tests were conducted by Universal Oil Products in regard to the desulphurization of the synthetic crude oil. Mr. Adams of Universal Oil Products said that his company would not hesitate in going from batch studies to a commercial plant design.

The applicant recognizes the problems associated with the proposed ninety-day start-up period and has prepared a schedule establishing a basis for the orderly transition from experimental to full scale operation. Overburden would be removed from a rather extensive area prior to the time that the plant would be ready for operation. Since conventional earth moving equipment could not handle the job alone an excavator and spreader would be provided approximately eight months before the plant completion date. Electric power would be required for such mining and conveying equipment and the completion of construction of the utility plant would coincide with the use of such facilities. The utility plant would require fuel oil for its operation since the normal fuel coke would not be available at that time. However, to keep this requirement to a minimum, one train of the extraction plant would be completed to extract oil for fuel at approximately the same time as the utility plant would be put into operation. The operation of the single extraction train would also serve as a training unit for subsequent operation. The remaining extraction trains would be completed prior to the balance of the plant and would be operated on a limited basis to build up an inventory of feed for the delayed coking unit. This would provide approximately six months to "line out the front end of the plant" including the refining operation before the balance of the plant would be completed and ready for operation.

The Board understands that the construction schedule is contingent upon the road and bridge as well as the mining and conveying facilities being completed according to schedule. In the Board's opinion ninety days does not provide sufficient time to solve all the problems likely to occur during the initial operation of the plant. Still, it feels that the effect of prolonging the period required to reach full production would affect only the economics of the project.

(c) Refining:

No serious questions were raised concerning the refining phase of the operation.

(d) Product Transportation:

The synthetic crude oil pipe line appears to be adequately designed to carry the product to Edmonton.

Considering the terrain and remoteness of the route for the proposed pipe line any criticism in regard to over-design should be discounted.

(e) Waste Disposal:

The proposed method of handling the tailings disposal during the initial three-year period has been seriously questioned by the interveners. It was stressed by Dr. R. M. Hardy that the relatively uniform particle size of the sand tailings plus the fact that these sand grains are lubricated with oil makes the material unstable when stacked at any significant slope, unless some means not included in the proposal were provided to increase the stability of the pile.

In reference to the proposal whereby a slurry consisting approximately of 40 per cent solids and 60 per cent water would be sluiced, Dr. Hardy stated that tests had been conducted under his direction on a similar slurry not contaminated by oil. He found that although the tailings would drain and the sand was relatively stable when it was dry, the wet sand was very unstable and would slide at the least provocation. He believed that with oil in the sand the condition would become more critical. He agreed that the sluiced tailings could be stacked temporarily at angles as high as 30 degress but contended that its inherent instability could result in mass slides of an unpredictable nature.

Witnesses for the applicant were of the opinion that the stability of the tailings pile could be increased by spreading or compacting the material within available area limits by interior diking and the suitable placing of rip rap.

The Board is of the opinion that the problem of initial sand tailings disposal has been given a minimum of study by the applicant. The evidence of the interveners on this subject is based on knowledge obtained in its pilot plant operations at Mildred Lake, and on field observations and laboratory work carried out by its consultants who are eminent in the soil mechanics field. The applicant appears to have relied on relatively limited experience on tailings disposal obtained during the Bitumount plant operation, plus opinions of its proposed equipment suppliers. While no clear-cut solution to the problem was presented at the hearing the Board believes that a solution could be obtained, although at a cost.

The Board staff has carried out detailed calculations of the stacking height and the angle required if the sand tailings from the first three years of operations were stacked over the entire area of the initial disposal site proposed by the applicant. These calculations indicate a maximum height of about 100 feet and a maximum angle of about 5 degrees. According to Dr. Hardy's testimony some slumping could occur to an even lower angle. The Board believes, however, that any problems which developed could be solved by compacting, the use of rip rap, or the admixing of stabilizers as suggested by the applicant.

The possibility that the initial tailings disposal area may be subject to damage by ice flows or floods was suggested by the interveners.

A witness for the applicant claimed that the area is at a sufficient height above the high water level to safeguard against such dangers. A tree belt would be left between the river and the dike on the east side of the disposal area.

It was the opinion of the interveners and witnesses from personal experience that difficulty may be encountered in finding suitable material in the immediate vicinity for construction of a dike to direct the drainage of water from the initial disposal area.

Mannix Co. Ltd., the contractor responsible for the dikes, proposes a dike constructed of material existing along the river bank, 8 feet high with a 16 foot top, enclosing the initial disposal area. Parallel to the dike would be a ditch 5 feet deep with a 14 foot bottom. Mr. G. W. Walker of Mannix Co. Ltd. stated that experience with similar materials used for building dikes and dams confirms his belief that the material for the proposed dike would be suitable.

The Board has difficulty assessing the difficulties associated with the dike and ditch. It is prepared to assume, however, that if difficulties were encountered that they could be overcome.

Representatives of the interveners stated their opinion that the drainage of water released from the initial tailings pile would be impeded by clogging of the pores of the underlying material by fine particles.

Representatives of the applicant stated their opinion that any clogging would be very slow and would not seriously affect the drainage of the tailings.

It is the opinion of the Board that this situation is not serious from the point of view of handling and recycling water since a recovery and recycle system would be provided to handle the drainage water. However, if drainage of the tailings were impeded the stability of the pile could be affected.

The question was raised by the interveners as to whether the initial tailings disposal by sluicing would be hampered by the build-up of ice during prolonged periods of cold weather.

The applicant has proposed insulated lines and housing for a portion of the conveying system as well as for valves and pumps. It contends that no serious freezing problems need be expected since the sluiced water would enter the disposal area at a temperature of approximately 100 degrees Fahrenheit. When excessive sub-zero temperatures occur, such as might be the case for part of January, the plant may have to be shut down.

The Board believes the applicant has underestimated the difficulties associated with cold weather operations.

It is the belief of the intervener that insufficient provision has been made for the safe stacking of the tailings in the mined out area after the initial three-year period. The volume of tailings and overburden returned would be almost the same as the volume of oil sands and overburden removed and, therefore, the sand tailings and overburden would have to be piled to approximately the original surface level.

It is the intention of the applicant to leave a wall of oil sands in place around the mined out area to prevent any possible sliding of the tailings beyond the mined out area.

The Board believes that the problem of instability within the confined mined out area remains and that it is aggravated by the great height of the tailings pile. However, a large area would be mined out before sand tailings would be returned to the quarry and in this way an inactive area would be left between the mining equipment and the tailings pile. If slumping of the tailings made it necessary, the situation could be improved further by leaving unmined walls of sand to act as dikes at critical locations in the mining area. Because of the expected instability of the tailings pile, the feasibility of operating the stacking machines from benches on it is in doubt, although the long boom for spreading the tailings would help somewhat. The situation could be improved by compaction and stabilization.

No problems were raised with respect to the disposal of excess coke. There is apparently no possibility of reducing the coke production in the delayed coking process as proposed for this plant.

The applicant appears to have adequately provided for the treatment and disposal of liquid wastes. As a result no pollution of the river is anticipated.

The question of contamination of the area around the plant site was raised by the Board's staff. With the proposed 300 foot stack for venting sulphur dioxide and conditions likely to prevail in regard to exit velocity and temperature and wind velocity, an area of about three square miles, for any given wind direction would have a ground concentration of sulphur dioxide in excess of the commonly acceptable limit of one part per million.

These concentrations could be reduced by increasing the stack height beyond 600 feet or by providing for sulphur recovery facilities. In either case additional capital expenditures would be required.

The Board believes that the proper solution to the air pollution problem is through the installation of sulphur recovery facilities.

In summary, the Board believes that the overall process is probably technically feasible but recognizes that some of the individual steps are not fully proven. Costly delays during the transition period leading to continuous integrated operation of the plant and problems regarding stacking of sand tailings are difficult to assess but must be expected. The impact of these problems seems to be underestimated by the applicant.

3. Contractors' Guarantees

During the hearing, Great Canadian called its own Mr. Clarke and representatives of its major contractors to deal at length with those provisions of the proposed contracts between Great Canadian and contractors which deal with price, throughput and guarantees.

Evidence was provided by Great Canadian that each of the contractors had stipulated a maximum price for the equipment or work to be done, provided that a contractual agreement had been reached between the contractor and Great Canadian before a stated date. Each contractor indicated that he was prepared to extend this date but some escalation in the guaranteed maximum price would probably be necessary. When examined by the interveners on the need for capital allowance for contingency and repair purposes, Great Canadian took the position that it had guaranteed maximum prices and, therefore, no contingency fund was needed for those parts of the overall scheme which would be contracted out.

Each guarantee resulted from bargaining between the parties to the contract in which it would appear, and although the general natures of the guarantees are similar, there is considerable variation in details. The typical guarantee provided that if the unit supplied by the contractor had a feed input of certain specifications, it would produce a specified output. The design output is, in all cases, substantially greater than that required to produce 31,500 barrels per day. Compliance with the guarantee would be determined by performance during the initial tests of the equipment. If the requirements of the guarantee were not met at that time the contractor would make such alterations or adjustment in the unit as would be necessary to enable it to perform successfully. However, the performance of a unit during the initial tests will not ensure its functioning during a continuous integrated operation. The guarantees also fail to touch on the moot question of operation under field condition on a year around basis except to the extent of the guarantee against defects in material or workmanship.

The value of the guarantees in assisting the Board in its consideration of the application is difficult to assess. Since all of Great Canadian's proposed contractors have excellent and world wide reputations in their fields, the moral recourse could be substantial. On the other hand, since integrated operational experience is lacking in the mining and processing of oil sands and disposition of the products and wastes, there is some doubt that operational conditions for design determination can be specified to the contractors by Great Canadian with any certainty. There is the possibility that a contractor might feel his moral obligation is limited to a point not much beyond that set by his guarantee. In some cases too, modification of the unit to overcome deficiencies might not be the most desirable remedy. The Board has concluded that in the event

Great Canadian were to sign contracts for the supply and construction of the various phases of its scheme, and such contracts were to specify a maximum price, then Great Canadian would have legal recourse for failure due to workmanship and materials, but only moral recourse for failure of design if input specifications were not those set out in the guarantee.

4. Economic Feasibility

The applicant, Great Canadian, submitted studies prepared by itself and by some of its contractors dealing with the various economic aspects of its proposal. During the progress of the hearing various minor amendments to cost figures were proposed by the applicant and most of these amendments were evaluated in a study prepared by Universal Oil Products on behalf of the applicant. Unless otherwise indicated, any reference here to the applicant's cost and related figures are taken from Universal's report, which was introduced as Exhibit No. 12 at the hearing.

In summary the applicant estimated that the capital investment required for the overall project would be about $100,700,000 consisting of $26,000,000 for the pipe line, bridge and road, $20,700,000 for the power station, tankage, etc. and $54,000,000 for the mining, conveying, extraction and refining equipment. The working capital required, which included such items as initial inventories, salaries during construction and start-up, insurance, interest, various professional and inspection fees and preproduction expenses, was estimated to be $11,434,000.

Studies by both the applicant and by Universal Oil Products of the estimated direct operating costs were presented to the Board. These costs were based on mining, refining and pipelining 31,650 barrels per day of synthetic crude oil and resulted in a direct cost of 70 cents per barrel in the case of the Universal study and 68.7 cents per barrel in the case of the applicant's study. The estimated direct operating costs included such items as labour, chemicals, royalties, supplies, property taxes, insurance and pension plan, but not such items as interest, financing charges or income tax.

During the hearing of the application the interveners, particularly representatives of the Cities Service group, by examination of the applicant's witnesses and by direct testimony attempted to show the Board where, in their opinion, the applicant had not made any provision, or insufficient provision, for various aspects of the proposed project. Having regard to the views of the applicant and the interveners and that of its own staff, the Board believes that the applicant either failed to provide for or made an insufficient provision for many necessary items. The Board does not contend that it can determine with accuracy the cost figures for all specific items in a project of this type but does believe that additional expenditures would be required. The Board's estimates of these expenditures are considered to be realistic rather than as maximum or minimum.

(a) Financial Structure:

The applicant proposes that of the total capital requirements of some $112,000,000, approximately 18.2 per cent or $20,400,000 would be raised by the sale of equity shares and the remainder by debt financing. The Board observes that this represents a high ratio of debt to equity capital. Such a ratio with its resulting leverage is probably necessary to attract the equity capital for a venture of the kind proposed. On the other hand, the high debt capital requirements resulting will undoubtedly add to the financing difficulties. The Board can readily see that the cost of financing would be considerably more than for projects requiring a lower leverage to attract the equity capital.

(b) Capital Expenditures:

No provision was made in the capital expenditures for the construction of a sulphur recovery unit. The project as proposed would vent an estimated 300 tons per day of sulphur as sulphur dioxide to the atmosphere. The Board believes it to be necessary in the interests of reducing air pollution and desirable from the conservation viewpoint that provision should be made for the recovery of this sulphur and its stock piling until a suitable market is available.

Most of the contract agreements for the equipment expired on July 1, 1960, and in one case the agreement was extended to December 31, 1960, with a slight increase in the original price. It was stated by one of the prime contractors during examination that extension of contracts for capital equipment could result in escalation of prices up to 5 per cent per year. No provision for escalation of any of the proposed contracts was made in the economic studies presented to the Board.

Both of the registered interveners at the hearing questioned the applicant's general lack of provision in the proposal for the continuance on an uninterrupted basis of the various operations under severe winter conditions. In particular, it was stressed that the waste disposal systems which would be handling considerable volumes of water were designed essentially to operate in the open and would be exposed to the weather. The Board believes that more winterizing than has been provided for will be necessary.

A detailed examination of the applicant's proposal for the removal of overburden from the initial mining area and of the disposal of wastes in the first five years leaves a serious doubt in the Board's mind that sufficient conveying equipment has been provided for these items.

The cost of financing the project was not included by the applicant. The applicant's financial witness stated at the hearing that these costs could be as high as 5 per cent of the total capital to be raised. The Board considers a figure of $5,000,000 (3.8 per cent) to be a reasonable estimate.

The Cities Service group, in direct testimony, seriously questioned the proposal by the applicant for the disposal of sand tailings. As a result of the intervener's testimony the applicant filed an additional agreement for a contract for the disposal of sand tailings. This additional agreement was filed after the hearing and was for an amount of $2,500,000. This amount is in addition to the proposed capital expenditures submitted at the hearing and was not included in the various economic studies and calculations submitted by Great Canadian.

Having regard to the evidence related to these items and also to representations by the interveners as to the inadequacy of the research and development work undertaken by the applicant, the Board estimates that the following additions to the applicant's proposed capital expenditures are proper and necessary:

(i) Add 3 per cent to the proposed capital costs to provide for escalation costs for one year.

(ii) Add 2 per cent to the total of the applicant's proposed capital expenditures to provide for contingencies.

(iii) Add $2,500,000 as proposed by the applicant after the conclusion of the hearing to provide for sand tailings disposal.

(iv) Add $2,000,000 to provide for the construction of a sulphur recovery unit.

(v) Add $5,000,000 to the total of the adjusted capital expenditures to provide for financing charges.

(c) Working Capital:

The applicant agreed during examination at the hearing that no provision had been made for "line fill" for the pipe line from the McMurray plant to Edmonton. This provision, including an allowance for working stocks, should be made.

A report of the economic evaluation of the proposal was prepared for the applicant by Universal Oil Products Company. In the working capital summary of this study the "start-up time", or the length of time between the end of construction and the commencement of continuous, full-scale operations (at an average capacity of 31,650 barrels per day of synthetic crude oil) was assumed to be ninety days. The interveners seriously questioned the ninety-day "start-up time" provision and a witness for the Cities Service group stated that, in his opinion, if the plant were built as proposed it would take several years after completion and millions of dollars to convert it to a commercially workable plant. The Board concludes that the proposal is based on a minimum of research and pilot testing and that for this reason a six-month start-up period would be more realistic.

The applicant's proposal assumes that interest on capital requirements during construction and start-up will be at a rate of 6 per cent. This interest rate was questioned by the Cities Service intervener and given considerable thought by the Board. Considering the general bond interest rate and the relatively speculative nature of the proposed venture, the Board is of the opinion that a rate of 7 per cent would be more reasonable.

No provision was included in the proposal for the start-up expenses which would be associated with the sulphur recovery unit.

In addition to the items listed above the Board believes that it would be realistic to include a general contingency item consisting of 5 per cent of the total of the preproduction expenses but not including the interest charges. In the Board's opinion the novel nature of the proposed project necessitates the provision of a contingency fund.

(i) Direct Operating Expenses.

The applicant did not provide for the operating expenses of a sulphur recovery unit because he did not provide for such a unit in the first instance.

The applicant filed an amendment to capital costs after the hearing to provide further for sand tailings disposal. The Board believes that the operation of this additional capital equipment will involve further direct operating costs not included by the applicant in the studies presented to the Board at the hearing.

The interveners seriously questioned the adequacy of the provision by the applicant for inventory of maintenance supplies. Considering the novel machinery to be used and the remoteness of the area, the Board believes the applicant's provision for this item to be much too low.

The applicant submitted evidence during

the hearing that pollution requirements had been discussed with the appropriate government bodies and were provided for in the costs. During the questioning, however, it appeared that it was quite probable that anti-pollution requirements would likely become more stringent with time. The Board has doubt that the cost of such increased requirements have been provided for in the proposed operating expenses.

A detailed report as to the labour costs for the operation of the project was made by Universal Oil Products Company on behalf of the applicant. A study of this report leads the Board to conclude that a proper escalation of the costs over a period of years was not made. The Board is further of the opinion that the management overhead costs as proposed by the applicant are on the low side.

The Cities Service group advised the Board at the hearing that they have had serious troubles moving machinery in the oil sands area having a lower bearing pressure than that proposed by the applicant. The Board believes that a contingency for this possibility should be provided.

The Cities Service group also contended during the hearing that Great Canadian had made insufficient provision in its proposed costs for additional operating costs during severe cold weather. The Board agrees that the applicant's provision for this matter was minimum and that a contingency fund should be provided for it.

The Board also concludes that insufficient provision has been made by the applicant for property taxes, particularly in regard to municipal taxes or their equivalent.

In summary the Board believes that an amount of about $250,000 per year should be added to the applicant's estimate to provide for the direct operating costs of the sulphur recovery unit and the sand tailings disposal system and that to cover the other items discussed above a contingency fund consisting of $557,000, being 10 per cent of the direct operating costs (excluding royalties payable) is necessary. The addition of these amounts to the proposed direct operating costs would increase the unit cost from 70 to 77 cents per barrel.

(ii) Indirect Expenses.

As stated previously the Board believes

that 7 per cent would be a more realistic interest rate than the 6 per cent used by the applicant.

The applicant agreed at the hearing that provision had not been made for the 3 per cent old age security tax in the economic evaluation of the project.

(d) Income:

Great Canadian used a price for synthetic crude oil delivered at Edmonton of $2.637 per barrel. The Board has checked this figure having in mind the contract of the applicant to sell the oil, and finds that the correct figure today is $2.6127 per barrel.

There would be a potential income from the substantial quantity of sulphur to be produced. However, due to the remoteness of the area and the present world over-supply of sulphur with little likelihood of a significant improvement for several years, the Board does not believe it would be realistic to assign any income from this product for the purpose of this study.

The Board has given consideration to the possibilities of a change in the price of crude oil and although it believes that a drop in price in the near future is more likely than an increase, the

Board has elected to base its calculations on the current price.

The following table gives the primary economic items as submitted by the applicant, together with the Board's estimate for the proposed project:

Item	Cost Estimate	
	Great Canadian	Board
Capital Expenditures:		
Pipe line, bridge and road	$ 26,000,000	$ 26,000,000
Power station, tankage, etc.	20,700,000	20,700,000
Mining, conveying, extraction and refining	54,000,000	54,000,000
Sand tailings disposal	--	2,500,000
Sulphur recovery unit	--	2,000,000
Escalation at 3% at $100,700,000 for 1 year	--	3,021,000
Contingency - 2% on $100,700,000	--	2,014,000
TOTAL CAPITAL EXPENDITURES	$100,700,000	$110,235,000
Working Capital:		
Site	$ 12,000	$ 12,000
Initial inventories	1,720,000	1,720,000
Operating expenses before "start-up time" - salaries only	300,000	300,000
Operating expenses after "start-up time" - salaries only	450,000	900,000
Training program	250,000	250,000
Insurance and pension	500,000	680,000
Interest during construction and "start-up time"	4,572,000	6,894,000
Pipe line fill and working stocks - 550,000 barrels at $1.00 per barrel	--	550,000
Working capital contingency fund - 5% of working capital (excluding interest charges)	--	448,000
Preproduction expenses	3,630,000	4,002,000
TOTAL WORKING CAPITAL	$ 11,434,000	$ 15,756,000
Cash Requirement:		
Capital Expenditures	$100,700,000	$110,235,000
Working Capital	11,434,000	15,756,000
Financing Charges	--	5,000,000
TOTAL CASH REQUIREMENT	$112,134,000	$130,991,000

Item	Cost Estimate	
	Great Canadian	Board
Equity Stock (based on 18.2% of total cash requirement proposed by applicant)	$ 20,408,000	$ 23,840,000
Debt Capital	91,726,000	107,151,000
Operating Costs:		
Project as proposed by applicant	$ 8,082,000	$ 8,082,000
Sulphur recovery unit and sand tailings system	--	250,000
Contingency fund - 10% of operating costs but not including royalty payments of any kind	--	557,000
TOTAL OPERATING COSTS	$ 8,082,000	$ 8,889,000
Depreciation:		
Pipe line, bridge, road, power station, tankage and contingencies at a 5% depreciation rate	$ 2,335,000	$ 2,451,000
Mining, conveying, extraction, refining and contingencies at a 10% depreciation rate	5,400,000	6,119,000
TOTAL DEPRECIATION	$ 7,735,000	$ 8,570,000
Interest and Operating Costs:		
Interest for 1st year after "start-up time"	$ 5,400,000	$ 7,502,000
Direct operating costs	8,082,000	8,889,000
TOTAL INTEREST AND OPERATING COSTS	$ 13,482,000	$ 16,391,000
Gross income per year after "start-up time"	$ 30,300,000	$ 30,046,000
Income tax rate after 3 years	47%	50%
Year after "start-up time" at which payout achieved	5.4	7.7

Economic Evaluation:

The applicant presented calculations for the payout period required to recover the debt capital using the cash generation method and starting when the plant had achieved full planned production (after "start-up time"). These calculations show a payout time of some 5.4 years for the recovery of the total indebtedness of $90,000,000.

For convenience the Board has adopted in its calculation of the payout period the same method as employed by the applicant. The Board also has assumed the same ratio of equity to total capital - some 18.2 per cent. On this basis the Board's calculations indicate a recovery of the total indebtedness of $107,151,000 in a period of some 7.7 years after the end of the "start-up time". It has occurred to the Board that the depreciation provisions made by the applicant and employed by the Board in its calculations may not be designed to take full advantage of Canadian income tax regulations. It may be that the depreciation for income tax purposes of certain of the equipment could be accelerated and that the income tax could be reduced in the early years. If this were possible the payout period using the Board's cost figures might be reduced by something approaching a year.

Mr. J. D. Wilkins, the financial witness for the applicant, indicated that it was possible that the ratio of equity to debt could be varied. If this ratio were increased reducing the debt capital required it could result in a further shortening of the period required for debt capital payout. To illustrate, if the equity could be raised on a 25 per cent equity - total ratio, and if full advantage of income tax regulations were taken, the payout of the debt capital, on the Board's figures would be about six years. The Board is inclined to doubt that the necessary equity capital could be raised at the 25 per cent ratio.

Mr. Wilkins testified during the hearing that anything over a six-year payout period would make the project "very chancy" to finance. The Board has no reason to disagree with this view.

5. Impact on Conventional Market

The Board has concluded from the evidence given by representatives of Sun Oil Company and Canadian Oil Companies, Limited that synthetic crude oil supplied from the Great Canadian plant would cause a reduction in demand for conventionally produced crude oil. In assessing the impact of this loss in market, the Board recognizes that most of the effect would occur in Alberta, and estimates that each barrel of synthetic crude oil supplied from the proposed plant would displace 0.8 of a barrel of Alberta crude oil and 0.2 of a barrel of Saskatchewan crude oil. In its calculations the Board has also assumed that the proposed Great Canadian plant would be completed by the end of 1962 and go on continuous stream after the start-up time by mid-1963. It has been assumed that production from mid-1963 would be at the full capacity of 31,500 barrels per day.

The Board estimates that the demand for Alberta crude oil in the last half of 1963 will be about 455,000 barrels per day, increasing to 490,000 barrels per day in 1964 and 530,000 barrels per day in 1965*. In these same periods the total economic allowance would be 370,000, 395,000 and 410,000 barrels per day. The table following indicates the estimated effect of the market curtailment on both the total market and the proratable market (total market less economic allowance).

ESTIMATED EFFECT OF THE PROPOSAL ON THE TOTAL AND PRORATABLE MARKET FOR CONVENTIONALLY PRODUCED ALBERTA CRUDE OIL

Year	Total Market BPD*	Economic Allowance BPD	Proratable Market BPD	Curtailment due to Proposal BPD	Percentage Effect on Total Market	Percentage Effect on Proratable Market
1963 (6 mo)	455,000	370,000	85,000	25,000	5.5	29.6
1964	490,000	395,000	95,000	25,000	5.1	26.6
1965	530,000	410,000	120,000	25,000	4.7	21.0

Approval of the Great Canadian application would cause a loss of approximately 5 per cent of the total demand for conventionally produced crude oil in Alberta, or some 20 to 30 per cent of the proratable market demand.

Relating this loss to individual well allowables indicates that in low productivity reservoirs well allowables would remain unchanged, whereas in high productivity reservoirs well allowables would decrease by as much as 20 per cent. The effect on typical wells is shown on the following tabulation.

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* Does not include the Montreal market.

ESTIMATED EFFECT OF THE PROPOSAL ON THE ALLOWABLES OF TYPICAL ALBERTA WELLS

	(a) Joarcam Viking		(b) Leduc-Woodbend D-3		(c) Bonnie Glen D-3	
Year	(1)	(2)	(1)	(2)	(1)	(2)
1963	25	25	40	39	142	129
1964	25	25	42	40	159	135
1965	25	25	44	40	171	142

(a) Typical low productivity well, MPR = 25

(b) Typical medium productivity well, MPR = 96

(c) Typical high productivity well, MPR = 633

(1) Estimated allowable assuming Great Canadian plant not in operation.

(2) Estimated allowable assuming Great Canadian plant in operation.

The Board has also considered the impact on the market for conventionally produced crude oil in relation to producing companies in Alberta. While both Canadian Oil Companies, Limited and Sun Oil Company have production in Alberta, their share of the proratable market is very small. The effect of the loss in market would, therefore, be borne largely by other producers and especially by those in the more prolific pools.

VI

FINDINGS

The Board and its staff have given full consideration to the evidence of the applicant and the views of the interveners on the questions of

(a) conservation and recovery of the crude hydrocarbon present in the oil sands,

(b) disposition of waste products and atmospheric and water pollution,

(c) technical feasibility of the process,

(d) economic feasibility of the process, and

(e) impact on the market for conventionally produced crude oil.

As a result of these considerations, discussed in this report, the Board concludes as follows:

(a) WITH RESPECT TO THE CONSERVATION AND RECOVERY ASPECTS OF THE PROPOSAL

The proposal of the applicant contemplates a sequence of mining, separating and refining operations which would result in a satisfactory conservation and recovery of the crude hydrocarbon present in the oil sands.

(b) WITH RESPECT TO THE DISPOSITION OF WASTE PRODUCTS AND ATMOSPHERIC AND WATER POLLUTION

Subject to certain technical difficulties anticipated by the Board, the applicant's proposal for the disposition of the solid and liquid wastes which would result from the process appears reasonably well conceived and designed to avoid serious pollution. (The applicant has indicated its preparedness to meet any reasonable requirements of the Board or Department of the Provincial Government in this respect.)

The applicant's proposal for the disposition of the gaseous wastes which would contain some 300 tons per day of sulphur is not considered satisfactory. If the application were approved the Board believes that it should be conditional on the recovery of a substantial portion of the sulphur in the interest both of reducing air pollution and of conserving sulphur. With such a provision the Board would be satisfied with the plan for the disposal of the wastes.

(c) WITH RESPECT TO THE TECHNICAL FEASIBILITY OF THE PROPOSED PROCESS

It is difficult for the Board to give an absolute ruling on the technical feasibility of the process. Certainly a process, along the lines of that proposed, could be developed into a technically feasible one. Many of the processing steps are straightforward and are unquestionably feasible in the technical sense. Some appear feasible on the basis of the fact that closely related operations have been carried out on a commercial scale elsewhere. Others are suggested to be feasible on the basis of laboratory tests, limited field tests, and/or contractors' "guarantees". The Board is not impressed with such "guarantees" as evidence of technical feasibility itself. The Board recognizes and respects the experience and good names of the contractors involved but cannot interpret their evidence or undertakings as proof of the technical feasibility of the process in which their equipment would be used. In addition to the questions in the Board's mind concerning the technical feasibility of certain of the steps of the process there is the further question of the technical feasibility of the integrated process proposed to be operated on a continuous basis and through adverse weather conditions.

The Board cannot ignore the fact that the Cities Service group, composed of experienced companies, has recently spent over $9,000,000 and proposes further expenditures of some $6,000,000 to study, by large pilot plant operations, the various steps of what is essentially the same process as that proposed by the applicant. In other words, while the applicant contends that the process is now ready for commercial development, the Cities Service group considers further large scale pilot tests necessary.

The Board takes the position that while the process proposed may well be feasible in a general sense its feasibility in a detailed technical sense is not yet fully proven. The Board does not hold that only a process which it considers completely proven in a detailed technical sense could be approved under Part VIA of The Oil and Gas Conservation Act. On the other hand the degree to which the process, in the Board's opinion, is proven as technically feasible is a factor which the Board considers must be given weight in deciding upon such an approval.

(d) WITH RESPECT TO THE ECONOMIC FEASIBILITY OF THE PROPOSAL

The Board has attempted to assess the economic feasibility of the proposal on the assumption that it could be considered technically feasible. In this assessment the Board has estimated certain cost increases consistent with its views as to the minimum impact on the economics of certain technical deficiencies. On the basis of this assessment and the overall nature of the proposal the Board has serious doubts as to the financibility of the project and, therefore, as to its economic feasibility. This conclusion is based upon the Board's estimate of a six to eight year payout of the debt capital which the Board believes, and on the applicant's own evidence, would be considered excessive (or "chancy") in financial circles.

(e) WITH RESPECT TO THE IMPACT ON THE MARKET FOR CONVENTIONALLY PRODUCED CRUDE OIL

The market proposed by the applicant is that of the Sarnia refineries of Sun Oil Company and Canadian Oil Companies, Limited. This market is one which otherwise would be supplied largely by crude oil conventionally produced from Alberta oil fields.

The Board recognizes that the scale of the proposed operations is about as small as could be considered. On the other hand the timing is such that the impact would come (last half of 1963 to 1965) when the total demand* for Alberta crude oil would be in the 455,000 to 530,000 barrel per day range and when the economic allowance would be in the 370,000 to 410,000 barrel per day range. The resulting decrease in total demand for conventionally produced Alberta crude oil would be about 5 per cent and the decrease in the proratable demand (total demand less economic allowance) would range from 20 to 30 per cent. Moreover, because of the relatively small Alberta production controlled by Sun Oil Company and Canadian Oil Companies, Limited, the burden of the marketing loss would be carried largely by other producers and especially by those in the more prolific pools.

(f) WITH RESPECT TO THE DISPOSITION OF THE APPLICATION

While recognizing the desirability of some commercial development of the oil sands in the near future, all things considered, the Board does not believe that it would be in the best interests of Alberta to grant the application at this time. Subject to the approval of the Lieutenant Governor in Council, therefore, the Board has decided to defer its final disposition of the application and to continue the application to June 30, 1962.

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*Assuming that Alberta crude oil does not enter the Montreal market.

The Board will be prepared to entertain a request made by the applicant at any time after January 1, 1962, and before June 30, 1962, for the reconsideration of the application provided that the applicant is able to offer substantial new evidence of the technical feasibility of the proposal, of the economic feasibility and financibility of the proposal and of a plan for the marketing of the synthetic crude oil which would have a less significant effect on the market for conventionally produced Alberta crude oil. If such a request is made the Board will consider it at a hearing called for the purpose.

If Great Canadian does not file with the Board on or before June 30, 1962, a request for reconsideration in accordance with the requirements of the preceding paragraph the application shall be deemed to be dismissed.

Respectfully submitted,

G. W. Govier, P. Eng.,
Deputy Chairman.

A. F. Manyluk, P. Eng.,
Board Member.

V. Millard,
Acting Board Member.

Dated at Calgary, Alberta,
this 17th day of November, 1960.

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